U.S. EPA BASE STUDY STANDARD OPERATING PROCEDURE FOR SAMPLING VOLATILE ORGANIC COMPOUNDS IN INDOOR AIR USING EVACUATED CANISTERS

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Prepared By:

Environmental Health & Engineering, Inc. 60 Wells Avenue
Newton, MA 02459-3210

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1.0 OBJECTIVE

The objective of this procedure is to collect a representative sample of air containing volatile organic compound (VOC) contaminants present in an indoor environment using an evacuated canister, and to subsequently analyze the concentration of VOCs, as selected by EPA. The procedure involves several steps including canister preparation, sampling of the indoor and outdoor air and the analysis of the samples collected.

VOC samples are collected indoors (at Fixed Sites 1, 3, and 5, as defined in the BASE Protocol) and at the outdoor site (Fixed Site 0), employing evacuated canisters (SUMMA® Canisters) connected to pre-calibrated low flow controllers.

2.1 GENERAL SAMPLING CRITERIA AND REQUIREMENTS

The critical issues involved for proper collection of VOC samples involve the preparation of the evacuated canister and flow controller, assurance of a constant flow rate over the sampling period, storage and shipping of the canister to prevent contamination, and the analytical procedures employed by the laboratory. Canisters and flow controllers must be prepared to ensure a clean, dry, evacuated canister that will neither adsorb nor emit volatile organic compounds. The air drawn into the evacuated canister must be at a constant rate over the time period for which the integrated sample is required. The storage and transport of the canister must occur without loss of sample or contamination by extraneous materials. Sampling from the canister and analysis for selected compounds will be conducted by prescribed analytical procedures (gas chromatography and mass spectrometry). The procedures that will be used for sampling and analysis will generally follow the steps outlined in EPA Method TO-14.1

2.2 REQUIRED EQUIPMENT AND SUPPLIES

- 6 evacuated SUMMA[®] canisters²
- 1 spiked SUMMA® canister
- 6 Pre-calibrated 10-hour low flow controllers³
- Two (2) medium size adjustable wrenches
- IADCS sample ID labels.
- Sample data sheet.

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¹ Compendium of Methods for Determination of Air Pollutants in Indoor Air, EPA, 1989.

² Supplied by Performance Analytical, of Simi Valley, CA.

³ Supplied by Performance Analytical, of Simi Valley, CA., Manufactured by Condyne Inc.

2.3 SAMPLING APPARATUS

The sampling apparatus consists of a SUMMA® canister with an attached precalibrated low volume flow controller for time integrated sampling. The flow controller has a critical orifice which ensures a constant flow rate during the sampling period. The flow controllers are set to fill the sample canister approximately three quarters full over a nine hour sampling period.

2.4 SET-UP AND SAMPLING

Prior to sampling, a flow controller is attached to each of the SUMMA® canisters used for sampling. This is done by first removing the canister from the shipping box and unscrewing the protective shipping cap covering the canister air inlet port. The flow controller is then connected to the air inlet port and tightened in place using the "swage" connector on the flow controller. A wrench must be employed to "swage" the controller into place. Once the flow controller is attached to the canister, it is ready for sampling. At this point, no air should enter the canister because the canister valve will still be closed.

Each canister used for sampling is labeled using an IADCS generated ID label. This label is affixed to the labeling card which is then attached to the canister by the use of a wiretie. These labeling cards and wireties are supplied by Performance Analytical as part of the canister shipment. IADCS ID labels must not be directly affixed to any portion of the canister. Each canister and flow controller has a unique identifying number assigned by the laboratory. These numbers are recorded on the sample sheet.

Canisters are set up at their appropriate sampling sites on either the evening prior to the sampling period (Tuesday) or on the morning of the sampling period (Wednesday). The exception is at the outdoor site where canisters must always be set up on the morning of the sampling period. Sampling begins on Wednesday morning of the study week at approximately 07:30 and continues until approximately 17:30 on Wednesday afternoon. These sampling start and stop times are typical. However, they should be adjusted appropriately to capture working of the study area occupants.

The sampling period is started by rotating the valve on the canister 1 1/4 turns in the counter clockwise direction (the opening of the valve is sensed by a sudden decrease in the knob resistance). The time that the valve is opened is recorded on the log sheet as "On Time". Also recorded on the logsheet is the IADCS ID label, the canister ID number as well as the flow controller ID number.

To end the sampling period, the flow controller valve is closed. The time that the valve is closed is recorded as "Off Time" on the log sheet. Once the flow canister valve is tightly screwed closed, the flow controller is then detached from the canister using an adjustable wrench, again taking care that the connector is not damaged in the process.

2.5 SAMPLING LOCATIONS

The fixed site sampling convention is as follows provided the study area can accommodate the configuration.

- Outdoor Site: One sample, one duplicate
- Fixed Site 1 (indoors): One sample
- Fixed Site 3 (indoors): One sample, one spiked sample⁴
- Fixed Site 5 (indoors): One sample, one duplicate⁵

Outdoor samples are collected under a protective shelter to ensure that rain or snow will not enter the flow controller. Indoor samples are collected at a height of 1.1 meters.

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⁴ Spiked samples may be collected at either site F1, F3, or F5.

⁵ Indoor duplicate samples may be collected at either site F1, F3, or F5 and may be placed based on site physical restrictions. Indoor duplicate samples shall not be collected across multiple fixed indoor sites (e.g., VOC duplicates at F1, particles at F3, and other duplicate samplers at F5).

3.0 QUALITY CONTROL

3.1 SUMMA® CANISTERS

The canisters are conditioned by heating the canisters to 120 degrees centigrade while purging them with humidified UHP nitrogen. The canisters are evacuated to 50 millitor using a high capacity vacuum pump. The canisters are cycled through a minimum of five evacuation and pressurization steps. The laboratory supplying the canisters will be requested to provide certification canister pressure testing cleaning procedure.

3.2 FLOW CONTROLLERS

Flow controllers are recalibrated for nine-hour sampling and are cleaned on a weekly basis to ensure proper functioning and to decrease the potential for cross-contamination among samples.

3.3 QC SAMPLES

There is no blank sampling associated with VOC sampling with evacuated canisters. For ensuring quality control with this sampling method, there are different sampling and analysis procedures employed. Specifically, these include the submission and analysis of a spiked sample, the submission and analysis of duplicate samples, and the submission and analysis of performance evaluation and performance demonstration samples.

To test the accuracy of the analytical procedures, canisters are filled at the laboratory with a spiked sample are delivered to the field team each week as part of the normal canister shipment. These spiked canisters are issued an IADCS generated ID label disguised with all other VOC samples and returned to the laboratory for analysis.

The repeatability (precision) of sampling and analysis is assessed by performing sample duplicates. Each week one set of duplicate samples is collected at a specified indoor

location and another set of duplicate samples is collected at the outdoor location. Performance evaluation and performance demonstration samples are prepared by an independent group and submitted once or twice per study, depending on the total number of field weeks.

4.0 SHIPPING AND HANDLING

A fresh lot of canisters (including the canister to be spiked) must be ordered for each week of sampling to reduce and standardize storage times. Leftover canisters can be used for sampling the following week, but canisters more than two weeks old will not be used.

The supplier of the canisters provides an ID number for each canister, and this number should be recorded on the field logsheet in addition to the BASE sample ID assigned by the Sample Custodian to each canister. Sample ID labels should be affixed to a tag tied to the outside of the canisters. Once the samples have been collected, they may be shipped in their original box to the laboratory for analysis.

The flowmeters must be disconnected from the canisters for shipping. The canisters must be shipped to the laboratory by overnight delivery on the day after the sampling is conducted.

5.0 CHEMICAL ANALYSIS

The air plus contaminants collected in the canisters is analyzed by high resolution gas chromatography/mass spectrometry by the methods outlined in Indoor Air Compendium, Method TO-14.